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ABSTRACT

Evaluating alternatives provides both the reason for and the technique of program budgeting for educational planning. The activities demanded by the program budgeting system allow systematic choosing of a preferred course of action. Within this system, alternatives are considered in the context of all other programs. This document presents concepts, techniques, and problems involved in educational program analysis. Data from a developmental program in the San Jose Unified School District are presented as a basis for the discussion. (Author/RA)

ANALYSIS OF EDUCATIONAL PROGRAMS WITHIN A PROGRAM BUDGETING SYSTEM

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INTRODUCTION

Evaluating alternatives is both the *why* and the *how* of program budgeting for educational planning. Being able to systematically choose the preferred course of action is the purpose of all the activities demanded by the program budgeting system. Within the system, alternatives are considered in the context of all other programs, not in isolation. For example, the cost of the alternative is calculated as an incremental cost to the cost of all other district programs. It is also conceivable that an alternative program could result in a less costly program--a rare occurrence in recent years.

We will discuss the concepts, techniques, and problem areas involved in the *how* of analyzing educational programs. As a basis for discussion, we will use the data from a developmental program being carried out in the San Jose Unified School District under Senate Bill 28. The example will illustrate most of the aspects of analysis.

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This material was presented on August 14, 1969, during the morning session, which was part of a 5-day program, "Program Budgeting (PPBS), A Resource Allocation Decision System for Education," given as an Academy Clinic by the American Association of School Administrators/National Academy for School Executives.

THE FRAMEWORK FOR ANALYSIS

An alternative program may be described in terms of certain basic characteristics--its effectiveness, its cost, and its resource requirements. The goal of analysis is not to provide the decisionmaker with the alternative that maximizes or minimizes specific characteristics; the goal is to provide information which together with the judgment of the decisionmaker permits a compromise among the characteristics of the alternative within the various environmental constraints, such as budget level.

An understanding of the framework of the analysis and the ground rules of the analysis is as important as the analysis itself. For this reason, we will describe very briefly the context of analysis. This may best be achieved by looking at the elements of analysis, the process of analysis, and the nature of a "better" analysis. We will also discuss the specific technique of cost/effectiveness analysis.

There are six major elements of the analysis:

Objectives. What educational aims are we trying to accomplish with the resources that the analysis is designed to compare? The choice of objectives is fundamental; if the wrong objective is chosen the whole analysis may be addressed to the wrong question.

Alternatives. By what alternative combinations of resources may the objective be accomplished? The generation of new and sometimes better alternatives is often an important by-product of the analytical part of the program budgeting process; this is partly due to the interaction of the decisionmaker and the analyst, but mainly due to the fact that additional analysis often results in a better understanding of the problems and the subsequent discovery of other alternatives.

Costs or Resources Used. Each alternative method of accomplishing the objective involves incurring certain costs or using certain resources. The resources (and cost) required for each alternative must be determined.

A Model or Models. Models are abstract representations of significant relations in the real world that may be manipulated and used

to predict others. The model is useful in tracing the relation between inputs and outputs, resources and effectiveness, for each alternative to be compared.

Criteria. By criteria we mean the rules by which we choose one alternative rather than another. They are the standards against which we measure the contribution of a program toward meeting the program objective.

Effectiveness Measures. These measure the contribution of the alternative toward meeting the objective. Ideally, they are not measures of workload, although in some cases this may be necessary.

The elements of the analysis then become inputs to the analytical process (Fig. 1). The process begins, of course, with the alternatives to be evaluated. These are examined within the model that represents the input-output or the resources-effectiveness relationships of the system. It tells what can be expected from each alternative. Essentially, it shows the *cost* of the alternative and the *contribution* of the alternative in meeting an objective. A criterion is then used to weigh the cost against performance. The purpose is not to determine one ratio of effectiveness to cost for an alternative but rather to rank alternatives. This information then provides a part of the basis for selection among alternatives. This is the quantified information for decisionmaking.

There is another important aspect of this process: it is the consideration of those dimensions of the problem that cannot be quantified--the qualitative or intangible factors which make it impossible to define a single satisfactory criterion.

It is not possible to say what makes a good analysis; it is possible to say what might help to make a better analysis. The fact that a set of procedures or exact rules still remains elusive is not a good reason to give up the search for ways to make the best of what is available. The search continues--with the dialogue between opponents and proponents helping most to clarify both the problems and the solutions. Several actions may help in the quest for a better analysis.

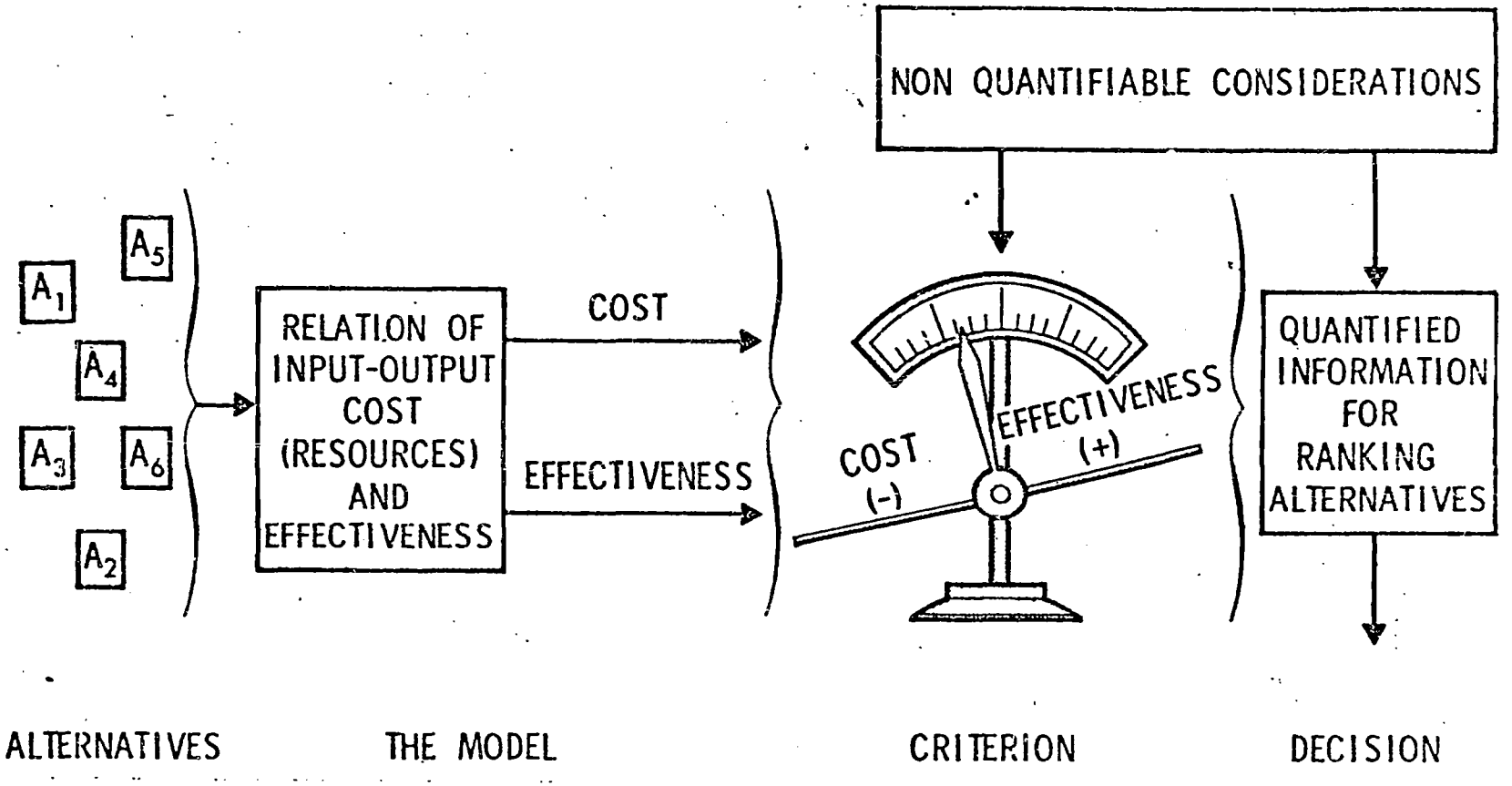

Fig. 1--The process of analysis*

*Adapted from E. S. Quade, *Systems Analysis Techniques for Planning-Programming-Budgeting*, The Rand Corporation, P-3322, March 1966.

First, be sure that the right problem is being addressed, that the analysis of the problem is seeking the answer to the right question. This includes not only deciding alternative ways to do something but also deciding what should be done. The right answer to the wrong question is, after all, rather useless. Important in deciding on the right problem is considering the interactions of other activities as they have a bearing on the problem. The complicating fact is that the really difficult problems are not isolated from their environment, and their solutions cannot be sought in isolation.

Assume success in divining the right problem to be studied and in designing the analysis to seek the answer to the right question. What is left? There is one important area over and above the analysis per se. It is the presentation of the results.

In the presentation of the analysis, the qualitative considerations should be identified. This includes both those taken into account in the analysis and those that could not be made an integral part of the analysis itself. It is important to present the results of the formal quantitative analysis, and interpret the results with special attention to the assumptions and limitations of the analysis. In addition, the analyst should attempt to identify the important qualitative considerations that the decisionmaker should try to take into account.

One additional thought should be mentioned. Analysis does not necessarily mean number juggling. A great deal can be gained from just a systematic approach to defining the problem and seeking possible solutions. Numbers, of course, do help. We all know that. We also know that some numbers are better than other numbers. The trick is to know as well as possible the meaning of the numbers: What do they tell you? Where do they come from? On what are they based? The point that should be emphasized is that numbers alone do not make a better analysis; the important facet is the context in which they are used and how they are used. The process of trying to make explicit some of the qualitative considerations inherent in defining the problem and in seeking possible solutions probably contributes more to making a better analysis.

The cost-effectiveness technique of comparing alternatives is the most widely known and the most often misused technique. It is useful in comparing alternatives when either the *cost* (budget level) or the *effectiveness* (achievement) is held constant. Maximizing the ratio for the sake of the ratio alone can lead to some ridiculous extremes--like zero to infinite cost or zero to infinite effectiveness. But there is a way to make the technique meaningful. That is, for example, to specify the level of effectiveness and then examine the *cost* of alternative means to achieve that effectiveness. Conversely, you can fix a single *budget level* and examine the levels of effectiveness that can be achieved through different alternatives. The ratio itself can be a very simple guide to ranking alternatives when two conditions exist: (1) the scale of the activity is fixed, and (2) the alternatives are not interdependent.

There are four purposes for which cost-effectiveness analysis can be used. The first is in the allocation of resources among major objectives. This is really a variation of the second and third purposes--the choice of alternative means to meet any given objective, and the assessment of the merit of different objectives. The fourth purpose is to provide the systematic generation of alternatives not initially identified.

We have chosen, in the following illustration, to examine the alternatives on an equal-cost basis. This approach focuses the attention of both the decisionmaker and the analyst on the effectiveness of the alternatives--the more difficult area in the cost-effectiveness analysis activity.

The next section provides a description of the developmental program, the R-3 Project, used as the illustration. This is followed by a discussion of the generation of equal-cost alternatives and a discussion of comparing the effectiveness of equal-cost alternatives.

DESCRIPTION OF PROJECT R-3

There are 35,000 students in the San Jose Unified School District, in which Project R-3 is being conducted. San Jose, California, is in the center of an area characterized by a large Mexican-American population and by rapid industrialization. In some neighborhoods in downtown San Jose, the concentration of Mexican-American residents can run as high as 70 percent. But prejudice against Mexican-Americans is slight compared to what one might expect to find in, say, Texas, so that there are job opportunities for ambitious Mexican-Americans in the San Jose area.

Population growth in San Jose has been more rapid than in the state as a whole, which, as you know, is itself characterized by rapid population growth. Population growth has had two effects. One is the loss of large areas of orchards and farmlands. In the past San Jose was known as a center for fruits and vegetables, but now many of the orchards are being cut down to make room for new homes. The other effect has been a large increase in nonagricultural employment, which more than tripled between 1950 and 1966. It is of particular interest that the electronics industry had become the largest single employer by 1966 in a town in which the canning industry had at one time been the largest employer.

The R-3 Project was funded under California Senate Bill 28, which was passed shortly after the Watts riot. Part of that bill was aimed at improving the achievement of students in the 7th, 8th, and 9th grades who were at least 1 year below grade level in reading or math and who were judged to be capable of doing better. Such children are characterized as underachievers.

"R-3" stands, not as you might think, for the three Rs--reading, writing, and arithmetic--but for readiness, relevance, and reinforcement. The concept behind the project is that the student is ready to learn when he is motivated; motivation is produced by showing the relevance of learning to the world of work; learning is made more lasting by reinforcement of acts which promote cognitive and affective development.

The objectives of the program were both short term and long term. The short-term objectives were to raise the students' achievement in reading and math beyond the normal for the target population, and to induce positive attitudes toward learning and education. The long-term objectives were to raise the educational and vocational aspirations of the students.

Three groups of students were chosen for the experiment. The program group which received the special treatment was chosen at random from a group of students in the 8th grade at Woodrow Wilson Junior High. These students were no more than 2 years nor less than 1 year below grade level in reading or math. (Actually, some of the students were above grade level in one or the other of these subjects.) The other criterion for student selection was chosen so that the project could be carried to successful completion. It was that the students would not be likely to move out of the district during the school year. Using these criteria, 17 boys and 17 girls were chosen for the program group.

The control group for comparison of academic achievement was chosen from another school in a similar socioeconomic area. This school had the same tracking program as Woodrow Wilson Junior High. All of the students were taken from the Y-track, which comprised students of average intelligence who were underachieving. No one in the district knew who the students in the control group were.

The third group was chosen for comparison on the basis of indicators of attitude toward school--primarily records of attendance and disciplinary problems. The comparison group consisted of all Woodrow Wilson 8th graders who qualified for the R-3 program but were not in it. The group was chosen from Woodrow Wilson students because the project personnel knew the backgrounds and environments of the students in this group, and also because these students would be treated with the same administrative policies for suspensions and expulsions as would the students in the program group.

The project had several components that could be grouped in a number of ways. We have chosen to break the project into three parts: remedial reading and math, the study of occupational technology, and the involvement of parents and students in special activities. We shall

describe each of these briefly. The subject-matter content of the remedial reading and math was not changed from that of the standard 8th grade curriculum. Each was given during one of two periods to classes of 15 students each, approximately half of the size of a normal class. A diagnostic/prescriptive approach was used. Initial diagnosis of reading difficulties was made by means of the Durrell reading test, and of math from the profiles of the students' performance on subtests of the California Achievement Test in math.

Occupational technology was taught through a variety of means. In the classroom, gaming and simulation were used with groups of approximately 15 students each. This activity was geared to the reading and math curricula and took one period every day. The gaming/simulation activity, which is how we will refer to this in the future, was a highly structured representation of real-world situations. Students played the roles of actual people, such as a park director or a highway engineer. Each unit was supplemented by a study trip to a facility directly related to classroom work. There were about 19 study trips throughout the year. Students helped to make the arrangements for the study trips by use of a conference phone.

The third component was the involvement of parents and students in special activities. We'll refer to this as *involvement* from here on. For involvement of the students, there were two study trips of 4 days each. Last year one trip went to Asilomar, a beautiful park on the Monterey peninsula; the other went to Big Sur, a park on the coast further south that contains a grove of coast redwood. These study trips were again very highly structured. They were intended to break down the stereotyped roles of students and teachers in the classroom and to involve students in a prolonged and intensive learning experience. It was apparent that they accomplished both of these goals. College students were used as team leaders for the learning activities.

The parents of the students in R-3 were also involved in the program. Before school opened, they were asked to attend a preschool dinner, where they were told what the program was to be about and where their consent was sought for the students to participate in the program in general and in the intensive involvement trips in particular. Since

this was a Mexican-American community, project personnel were afraid that a number of the parents would not approve of their girls going on the intensive involvement trips and thereby violating some of the traditions surrounding Mexican-American girls. However, this did not come to pass. In addition, the parents were invited to all of the study trips that accompanied the gaming/simulation activity, to the intensive involvement trips, and to several other dinner meetings throughout the year. At every one of these activities the parents participated along with the students and teachers. For example, they played some of the games during the dinner meetings, and whereas the students were teaching the parents at the beginning, the parents were taking great pride in teaching their children toward the end of the sessions. Finally, the teachers made home visits to all of the parents during the course of the year to discuss some activity connected with their children's participation in the program. This assured that each visit had a clear purpose so that the parents were at their ease.

The results of the project can be expressed in terms of both its cost and effectiveness. The cost figures, however, are not completely relevant for planning purposes because the project was not originally designed with the objective of keeping cost down. Therefore, many of the costs are considerably higher than they probably need to be. For example, teachers in one of the other schools in the district became so interested in the intensive involvement trips that they decided to design their own. Many teachers donated their time to planning the trip, surplus foods were used, and instead of staying at the dormatories at Asilomar where the R-3 program was housed, the students went camping. The result was that this trip cost only a third as much as a trip for the R-3 program. Of course, because the students were camping--and if any of you have ever been camping, you will know this is true--most of the time had to be spent in housekeeping chores so that the learning experience was not as concentrated as it was on the R-3 trips.

We shall express the effectiveness of the project in two ways. The first, displayed on Fig. 2, is academic achievement. You will note that in both reading and math the program and control groups were fairly well matched at the beginning, but that by the end of the year the

AVERAGE READING GRADE PLACEMENT (FROM CAT)

	Boys		Girls	
	R-3	C-3[a]	R-3	C-3
Pre	6.7	6.6	6.9	6.4
Post	8.4	7.9	8.9	7.5
Gain	1.7	1.3	2.0	1.1

AVERAGE ARITHMETIC GRADE PLACEMENT (FROM CAT)

	Boys		Girls	
	R-3	C-3	R-3	C-3
Pre	6.7	6.5	6.9	6.7
Post	7.9	7.0	8.3	7.5
Gain	1.2	0.5	1.4	0.8

[a]C-3 denotes the control group.

Fig. 2--Academic gains

program group had gained more in both reading and math than had the control. These gains were significant at the 5 percent level. We want to point out that the achievement testing was given under standardized conditions and under the supervision of a counselor.

We have only rough indicators for attitude change. These are given in terms of attendance and suspensions (Fig. 3).* We expressed these as a rate, that is, number of absences per student-day and number of suspensions per student-day, in order to take account of the different lengths of time and the different numbers of students in the fall and spring semester and in the R-3 and the comparison group. We have no way to measure the significance of these differences. We note that both the program and comparison group had more absences and suspensions in the spring semester than they did in the fall, and we also note that this change was not as great for the program group as it was for the comparison group.

Other results are of interest. One of these had to do with parent attendance at the program functions. This averaged 85 percent for all program functions, compared with about 16 percent for PTA meetings and other school functions. Of great importance to the school and the community was the improvement in the school image in the community. School personnel knew that professional agitators were trying to stir up trouble against the school, but for the past 2 years the agitators have been unsuccessful. The school principal attributes their lack of success primarily to the influence of the R-3 program. Finally, the school has gained a reputation for innovation within the district and among other California school districts evidenced by many visits to the school by people interested in the program.

The program has been given in toto up to this point, and there is no way, therefore, to know which of the components we have discussed is primarily responsible for the achievement gains and for the attitude change. Project personnel would very much like to experiment in order

*Pre- and post-tests of attitudes toward school and career were also administered to the program group. Although these tests did indicate attitude changes in the desired directions, the reliability and validity of the measures are not known.

	Days Absent Per Pupil-Day	Days Suspended Per Pupil-Day
Fall Semester		
R-3	.084	.0008
C-3	.110	.0004
Spring Semester		
R-3	.098	.0020
C-3	.151	.0132

Fig. 3--Attitude indicators

to isolate the effects of the various components. Then a school district wanting to institute a program of this kind could choose those components which were most effective, if any of them are without the others. This experiment, however, may not be funded. Nevertheless, the project personnel are going to continue to follow the students who have been in the program. Information will be gathered on their academic progress, including the courses chosen in high school as well as their grades and scores on standardized tests; and on student attitude, primarily as evidenced by suspensions, expulsions, attendance, dropouts, police contacts, and clubs joined. If possible, patterns of college entrance and vocational choice will be noted, for of course these are what the program primarily was aimed to change.

GENERATION OF EQUAL-COST ALTERNATIVES

In using the R-3 Project as a basis for illustrating the analysis of educational programs, we have made every effort to convey the intent of the demonstration program. We have, however, taken great liberties with the cost of the program. Because of this a word of caution is necessary at the very beginning: The cost of the alternatives, of their components, or of the specific items of equipment used in this illustration does not reflect the cost of the program just completed in the San Jose Unified School District. Our purpose is to show how cost analysis may be done so that the results are useful in the evaluation of alternative programs. The emphasis will be on *analysis for planning* rather than on *accounting for budgetary or financial control*.

This distinction is an important one. It demands an approach quite different from the traditional cost accounting procedures. The most basic difference concerns *what* is included in the cost estimate of the program. This means we are really interested in resource analysis as contrasted to cost analysis; we want to know what the dollars are buying. Having a cost-per-student measure of alternative programs is not sufficient. For decisionmaking purposes we want to know the requirements for special teachers, new equipment, additional facilities, and so on. We can then translate these requirements into an estimate of cost.

In analysis for planning, we might use techniques for translating requirements into cost estimates that would be unsatisfactory from a cost accounting point of view. In developing an estimate we would be happy using, say, $12,000 per year for a teacher--without breaking the $12,000 down by the amounts for each regular budget appropriation categories such as instruction, retirement fund, or fringe benefits. This kind of breakdown is, of course, required in cost accounting for budgetary control or accountability. But our main concern is to provide information about the resource demands of the alternative programs and to use a monetary measure of these demands as a convenient way to compare alternative configurations of the R-3 Project.

The R-3 Project of our illustration may be described in terms of three basic components: the remedial reading-and-mathematics component; the intensive involvement of the students, with parental involvement; and the gaming/simulation component. We have identified various mixes of these components as *options*. These, along with the cost for units of 30 students, are shown in Table 1.

Table 1

COST OF OPTIONS
(for units of 30 students)

Components of the R-3 Project

#1 Remedial Reading and Mathematics
#2 Intensive Involvement and Parental Involvement
#3 Gaming/Simulation

Options

A Components #1, #2, and #3	$27,130
B Components #2 and #3	18,990
C Component #1 only	13,140
D Component #2 only	8,675
E Component #3 only	10,315
F Components #1 and #3	18,455

The following assumptions are used in the calculation of the estimated cost of each option and in the generation of the equal-cost alternatives. For each component requiring classroom instruction, a regular class of 30 students is separated into two classes of 15 students each. Each classroom is remodeled in a sense. The floors are carpeted, walls are painted, and new furnishings are added. This is in addition to the special furniture (trapezoidal tables, for example) and equipment of each component. The classrooms can be used for six periods per day; utilization rates above this level require the preparation and outfitting of an additional classroom. The estimate for this is $3,000 for the classrooms and $2,000 for the furniture.

Instruction estimates are based on one incremental period for every two classes of 15 students. That is, one class of 15 is taught by the teacher of the regular 30 students and the other class of 15 is taught by the additional teacher. No special training is required for the

teachers. And there is no special qualification needed to teach the classes of any component. It is assumed that the cost of instruction is $11,715 per year, based on a five-period instructional day. This figure includes the salary of the teacher and all fringe benefits. The estimate for instruction is, on this basis, $2,345 a class period. These supporting cost details are given in Table 2. The cost of equipment and materials is also given in Table 2.

The cost related to the classroom is separated from the cost related to the number of students that use the classroom (perhaps six different classes of 15 students each). The cost related to the classroom (shown in Table 3) varies from $5,160 for Option E, *Gaming/Simulation Only*, to $8,660 for Option A, *All Components*. The cost related to the number of students receiving classroom instruction (Table 4) varies from $4,705 for Option E to $18,470 for Option A. The cost of the involvements (for groups of 30 students) is also shown in Table 4.

We now have enough information to look for some equal-cost alternatives. In evaluating the effectiveness of the alternatives, we have chosen Option A as the basic alternative for comparison. This is the option that includes all the components of the R-3 Project: the remedial reading and mathematics, the intensive involvement of the students, the parental involvement, and the gaming/simulation component. The following alternatives are selected:

Alternative I:	Option C for 90 students	$24,320
II:	Option D for 90 students	25,025
III:	Option E for 150 students	29,135
IV:	Option F for 60 students	28,750

The cost of each of these alternatives is shown in Table 5 and is within 10 percent of the cost of Option A. This is simply an arbitrary rule chosen for this illustration. Notice that it eliminates Option B, at a cost of approximately $32,000, from consideration as an equal-cost alternative. Option C for 90 students makes use of the classrooms for the six periods of the day; additional students would require the remodeling and outfitting of additional classrooms and would make the cost of Option C more than 10 percent over the cost of Option A. This

Table 2

SUPPORTING COST DETAILS

Item	Unit Cost ($)	Cost/30 Students ($)
Remodeling Classrooms	3,000	--
Furniture	2,000	--
Classroom Materials		
Reading & mathematics	350	--
Gaming/simulation	50	--
Classroom Equipment		
Reading & mathematics	2,200	--
Gaming/simulation	560	--
Equipment for Involvement	500	--
Materials for Student Use		
Reading	~ 16	475
Mathematics	~ 14	425
Gaming/simulation	~ 12	360
Intensive Involvements	--	6,775
Parental Involvements	--	1,400
Gaming/Simulation Trips	--	2,000
Instruction (per period)	2,345	--

Table 3

CLASSROOM-RELATED COST[a]

Item	Option A ($)	Option B ($)	Option C ($)	Option D ($)	Option E ($)	Option F ($)
Remodel Classrooms	3,000	3,000	3,000	--	3,000	3,000
Furniture	2,000	2,000	2,000	--	2,000	2,000
Classroom Materials						
Reading & mathematics	350	--	350	--	--	350
Gaming/Simulation	50	50	--	--	50	50
Classroom Equipment						
Reading & Mathematics	2,200	--	2,200	--	--	2,200
Gaming/simulation	560	560	--	--	560	560
Involvements[b]	500	500	--	500	--	--
Classroom-Related Cost	8,660	6,110	7,550	500	5,610	8,160

[a]This is the cost to provide the space, equipment, and materials for two classes of 15 students each. The cost of the alternative is based on being able to use the classrooms for 6 periods a day.

[b]This is the cost of equipments for both games of the intensive involvements--the Land Grant Game and the Oceanography Game.

Table 4

STUDENT-RELATED COST[a]

Item	Option A ($)	Option B ($)	Option C ($)	Option D ($)	Option E ($)	Option F ($)
Remedial Reading						
Materials	475	--	475	--	--	475
Instruction	2,345	--	2,345	--	--	2,345
Remedial Mathematics						
Materials	425	--	425	--	--	425
Instruction	2,345	--	2,345	--	--	2,345
Gaming/Simulation						
Materials	360	360	--	--	360	360
Instruction	2,345	2,345	--	--	2,345	2,345
Trip expense[b]	2,000	2,000	--	--	2,000	2,000
Involvements						
Intensive	6,775	6,775	--	6,775	--	--
Parental[c]	1,400	1,400	--	1,400	--	--
Student-Related Cost	18,470	12,880	5,590	8,175	4,705	10,295

[a]Based on 30 students.

[b]Based on approximately 20 trips per year with an average cost of $100 per trip.

[c]Based on experience data with 30 students. This includes the cost of 3 dinner meetings with the parents.

Table 5

GENERATION OF EQUAL-COST ALTERNATIVES

Item	Option A ($)	Option B ($)	Option C ($)	Option D ($)	Option E ($)	Option F ($)
Classroom-Related Cost	8,660	6,110	7,550	500	5,610	8,160
Student-Related Cost	18,470	12,880	5,590	8,175	4,705	10,295
Cost for 30 Students	27,130	18,990	13,140	8,675	10,315	18,455
Cost for 60 Students	45,600	31,870	18,730	16,850	15,020	28,750
Cost for 90 Students	72,700	44,750	24,320	25,025	19,725	47,205[a]
Cost for 120 Students	91,200	57,630	37,460[a]	33,200	24,430	57,500
Cost for 150 Students	118,330[a]	70,510	43,050	41,375	29,135	75,955[a]

Note: Option A - Remedial Reading & Mathematics, Involvement, Gaming/Simulation.
Option B - Involvements, Gaming/Simulation.
Option C - Remedial Reading & Mathematics, only.
Option D - Involvements, only.
Option E - Gaming/Simulation, only.
Option F - Remedial Reading & Mathematics, Gaming/Simulation.

[a]Additional classrooms required of over 60 students in Option A or C and if over 90 students in Option F.

would result in the elimination of Option C for more than 90 students as an equal-cost alternative.

From what might be called the decision matrix of Table 5, we have selected the set of equal-cost alternatives used in the following discussion on comparing the effectiveness of alternative programs. We could have just as easily selected a different set for a budget level of about $45,000.

In an effort to keep this discussion brief, we have given just the flavor of the ideas involved in making the results of cost analysis useful in the evaluation of alternative courses of action. The important consideration is that of providing the decisionmaker with information about the resources needed for each alternative as well as the cost of the alternative. In an actual evaluation you would need much more detailed information than we have given in this illustration. You would need a good picture of your existing resources, how they are used and with what effectiveness. This is necessary not only to determine the incremental cost of the specific alternative but also to compare the effectiveness of the alternative with the effectiveness of current programs. Information of this nature is readily available within an operational program budgeting system. In fact, organizing the informational data base to permit the systematic evaluation of alternatives is the primary objective of a program budgeting system.

COMPARING THE EFFECTIVENESS OF EQUAL-COST ALTERNATIVES

First, we shall discuss the primary objectives of each of the components of the R-3 program. Originally, the program was designed so that all of the components would support one another in attaining the two objectives: improved achievement in reading and math, and an improved attitude toward education. But when we consider each component separately, it does seem that we can identify one or the other of these two objectives as being the primary objective of a given component. For example, the primary objective of the reading and math program was clearly to improve the students' academic achievement in reading and math. Some change in the students' attitude toward school might have been induced because of improved achievement, but the *primary* objective was improved achievement.

On the other hand, the involvement appeared to be oriented to improving the attitudes of both the students and their parents toward school. (Actually, the involvement also changed the teachers' attitudes toward their students and toward the students' parents as well.) Many of the project personnel believe that the most essential part of the whole R-3 program was the parental involvement because it opened lines of communication that had not existed before. The parental involvement was required for a variety of reasons. Of course, the parents' consent was required for the students' participation in the program, but there were also effects on the way the parents looked at the role of education in their children's lives. Before the R-3 program, the parents had lacked a realistic appreciation of modern requirements for entry skills into the job market. Many of them had grown up making a living on the farm or in the canneries, and they did not understand that these jobs were becoming far less important for their children than some of the more highly technical jobs that were developing in San Jose. This lack of appreciation, coupled with strong family ties, resulted in parental urging that the students quit school so that they could contribute to the family income. Many families had large numbers of children and needed this extra money.

Although it would seem that the involvement was primarily aimed at attitude change, some of the project personnel thought that the intensive involvement trips were really the most influential component for improvement in academic achievement, as well as for attitude change. They believe that this is because the trips provide a dramatic break with traditional instruction, that they get the students away from the negative triggers that they have learned in their prior school experience. These people pointed out that even the limited intensive involvement trip that was conducted at the other school actually resulted in improvement in academic achievement. (We can think of a number of reasons for this; for instance, much of the school was involved in planning this intensive involvement trip, and therefore the teachers' attitudes toward their students were changed, as well as the other way around.) Whether the involvement really was principal in improving academic achievement will have to be resolved by further experimentation. Lacking this experimentation, all we can do for the present is to point out the effects of the two different assumptions on the choices that one would make among the components. The one assumption is that the improvement in academic achievement primarily came from the reading and math program, and the other assumption is that it was caused by the involvement.

The third component, gaming/simulation, showed how the program in reading and math was related to the world of work. Thus, it reinforced the reading and math and it also effected attitude change. Therefore, we shall assume that gaming/simulation had both objectives.

Figure 4 shows which of the components is assumed to have which primary objectives. As you see, academic achievement is primarily attained through the reading and math program, supported by gaming/simulation. A positive attitude toward school is induced by the involvement, and also supported by gaming/simulation. And there is a question as to whether the involvement was important for improving academic achievement.

Let us now consider various aspects of measures of effectiveness. One aspect has to do with the effects of the program over a longer period of time than we have been talking about up to now. (Of course, R-3 has not been in operation long enough for long-run effects to have

PRIMARY OBJECTIVES OF R-3 COMPONENTS

	READING & MATH	INTENSIVE INVOLVEMENT & PARENTAL INVOLVEMENT	GAMING/ SIMULATION
ACADEMIC ACHIEVEMENT	X	?	X
POSITIVE ATTITUDE TOWARD SCHOOL		X	X

Fig. 4

been observed.) Figure 5 displays the rate of growth in achievement in reading by grade. Normal growth, which is represented by the dashed line, would be indicated if a student was achieving at the 5th-grade level in the 5th grade, at the 6th-grade level in the 6th grade, and so forth. The rate of growth for Mexican-American students (Coleman, et al., 1966) is shown by the solid line. Because the Coleman report gave reading achievement levels only for the 6th, 9th, and 12th grades, the growth rate by grade can be inferred only very roughly, as indicated.

A program like R-3 is intended to raise the growth rate at least to normal and, ideally, to provide sufficient initial growth that the student makes up for prior years of underachievement. Figure 6 shows some of the possibilities. The R-3 program succeeded in the 8th grade in raising the students' growth rate to 1.8 months per month, as represented by the sharp peak, while in the 9th grade the growth rate was 1.1 months per month. In the future the students may drop back to their originally falling achievement or to normal growth, or they may even continue to grow at a somewhat greater rate than normal.

Another aspect of effectiveness is the effect of changes in one achievement measure on other measures not affected by the program directly. Logically, one might think that if a student's performance in reading has been improved, his performance in other subjects would also improve, particularly those such as science that require reading skills. Therefore, perhaps the R-3 program has also raised the students' achievement in science above normal growth, as suggested by the upper dash-dot line on Fig. 7. But it is also quite possible that the science program has suffered by comparison with the R-3 activities. In that case, the students' performance in science may even drop below the normally low achievement for this population. Thus, we must measure the students' achievement in *all* areas of interest so that we will know what the indirect effects are, if any.

Other measures also are needed, especially if the program involves more than, say, 100 students. In that case, we will need background data of the type that is being collected for the evaluation of all of San Jose's compensatory programs (Rapp, et al., 1969). These data are required so that the effects of varying backgrounds on student achievement

LONG-TERM GROWTH IN READING ACHIEVEMENT

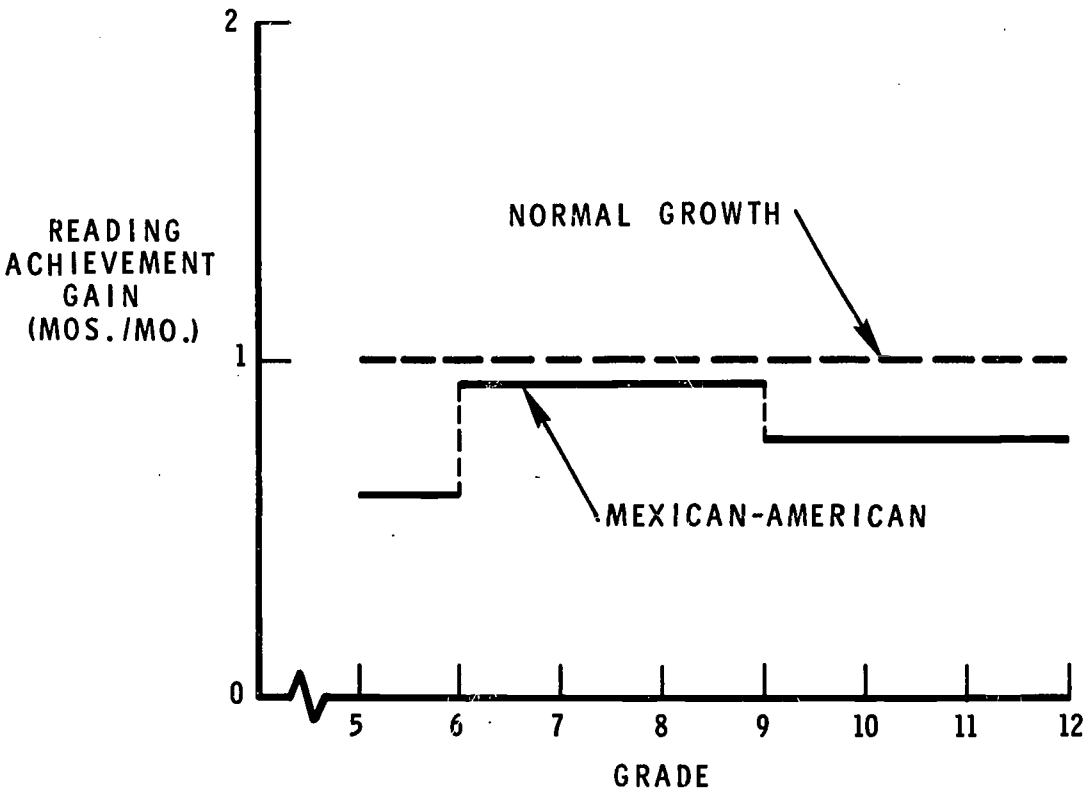

Fig.5

LONG-TERM GROWTH IN READING ACHIEVEMENT FOR R-3 PROGRAM

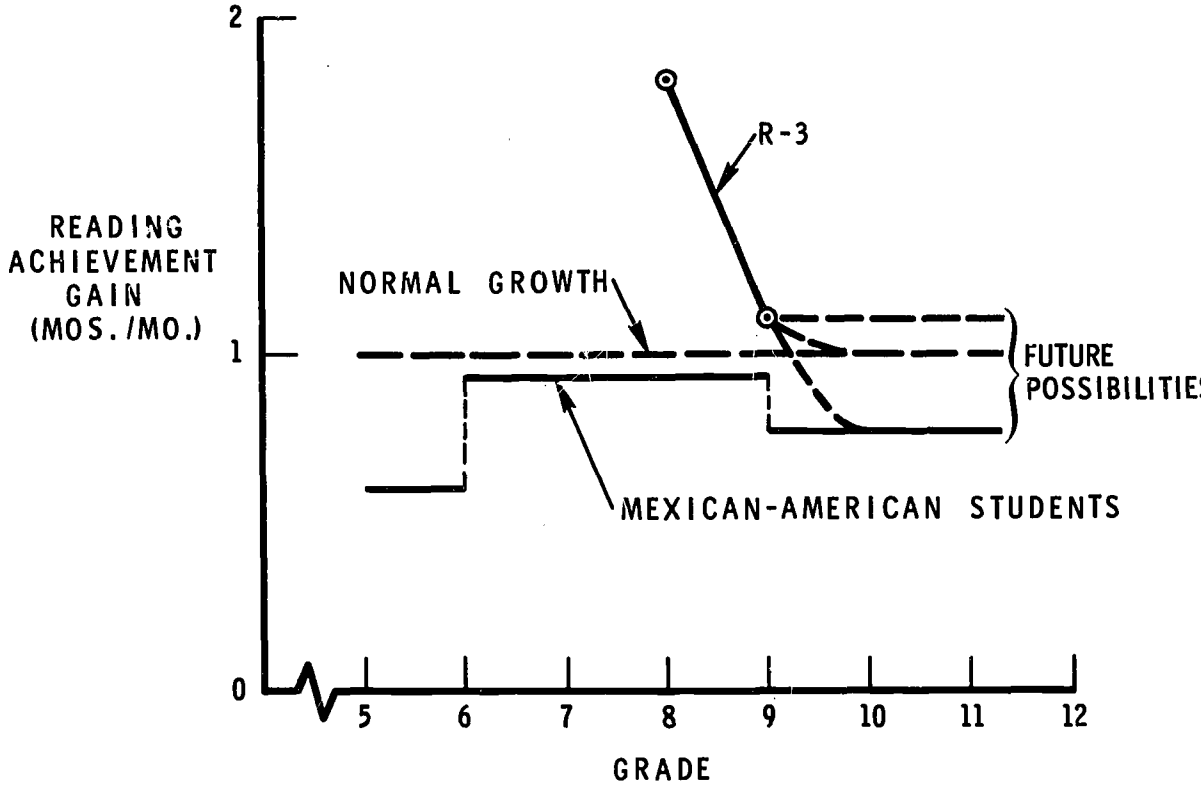

Fig. 6

EFFECTS OF READING ACHIEVEMENT GAINS ON ACHIEVEMENT IN SCIENCE

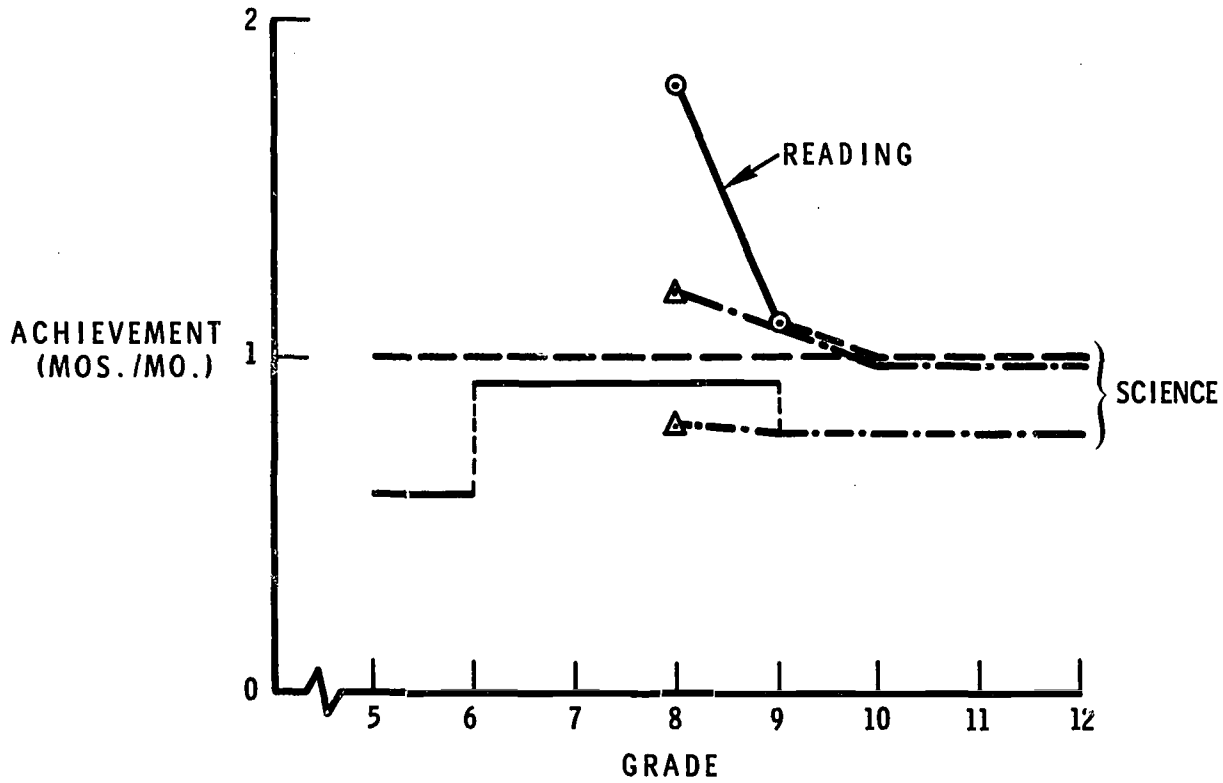

Fig. 7

can be isolated from the effects of the programs. The San Jose survey will assess background in five areas: the parent's view of the child, the parent's view of the school, family history, language patterns (important for Mexican-American populations), and economic status. Follow-up information of the type that will be gathered on those who participated in R-3 is also needed because, of course, planners are primarily concerned with longer-term effects. Recall that among the data to be gathered are dropout rate, police contacts, patterns of college entrance, and patterns of vocational choice.

Now let us compare the hypothetical effectiveness of the equal-cost alternatives that have been described previously, and that were chosen so that the decisionmaker may concentrate his deliberations on effectiveness. These comparisons will be made using two different assumptions. The first assumption is that the reading and math programs were primarily responsible for gains in academic achievement. Figure 8, based on this assumption, shows growth in reading achievement in months per month versus the number of students involved in the alternative programs. The first point on the figure, labeled "all," represents the 1.8 months-per-month gain attained by the 30 students in the R-3 program. (At present, of course, "all" is the safest alternative to choose because there are no data on the effectiveness of the others.)

Now if the components are recombined into the equal-cost alternatives, there will probably be changes in achievement growth and there will also be changes in the numbers of students involved. For example, although the gaming/simulation activity might not induce as much achievement gain as would the total program, it could be provided to five times as many students. It might, however, be too close to the dashed line--indicating 1 month per month, or normal growth. The dashed line is critical because the State of California considers any achievement growth less than this to be unacceptable. This would mean that, although the involvement could be given to 90 children for an equal cost, it would not be acceptable if the achievement it induced fell below the critical minimum, as suggested. If the district is not required to meet a minimum standard in achievement gain, it will be

EFFECTIVENESS OF ALTERNATIVES —FIRST ASSUMPTION

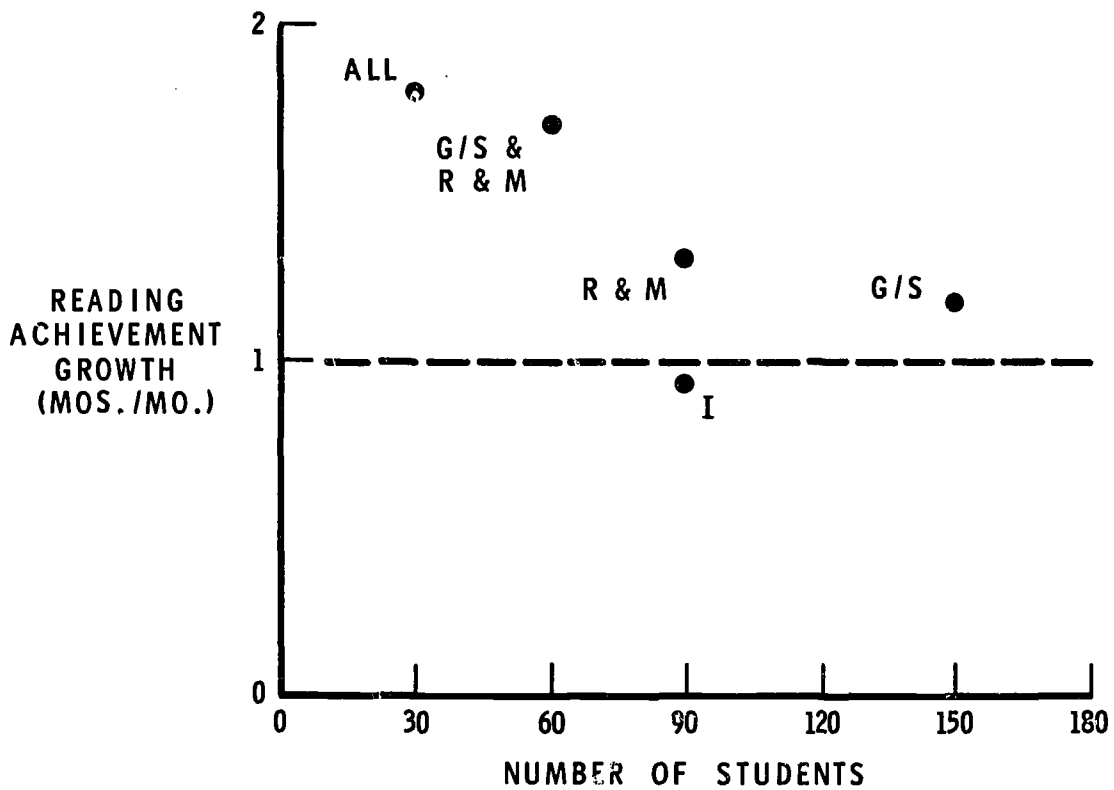

Fig.8

possible to trade off achievement gain on the one hand and the number of students reached on the other. This might be an important consideration if the schools need visibility. In that case the gaming/simulation would always be the best choice, because it is the least expensive per student.

The other two alternatives shown may more than meet the minimum requirement so that the choice between them would depend on whether one felt it more important to provide a higher rate of achievement to fewer students or a lower rate of achievement to more students. Because the reading and math program is not particularly innovative, one might be more interested in the gaming/simulation plus reading and math, even though it can be given to only 60 students.

Now suppose that we assume that the involvement was primarily responsible for the achievement gain rather than the reading and math. Figure 9 is based on this assumption. Again, all components working together account for a 1.8 months-per month growth in reading achievement for 30 students, but reading and math and gaming/simulation have dropped because they have been assumed to contribute relatively less to reading achievement. In fact, either of these alternatives might not be acceptable because they appear to fall on the critical line. The involvement has moved above the line, and since the involvement applies to 90 students, it looks like a very attractive alternative. In fact, it would appear that the involvement might be superior to the combination of gaming/simulation with reading and math, both in terms of achievement and number of students reached. On the other hand, in some districts it may not be possible to maintain discipline among the students for the extended period that they must be away from the school and home on the intensive involvement trips. If this is a significant problem for the district, the involvement would be an unsafe choice, and it would be better to select the gaming/simulation and reading and math.

Now let us include another measure of effectiveness in our analysis. Two measures of effectiveness--one, growth rate in reading, and the other, an index of attitude change for each program--are shown on Fig. 10. This index was derived by assuming that each alternative would

EFFECTIVENESS OF ALTERNATIVES — SECOND ASSUMPTION

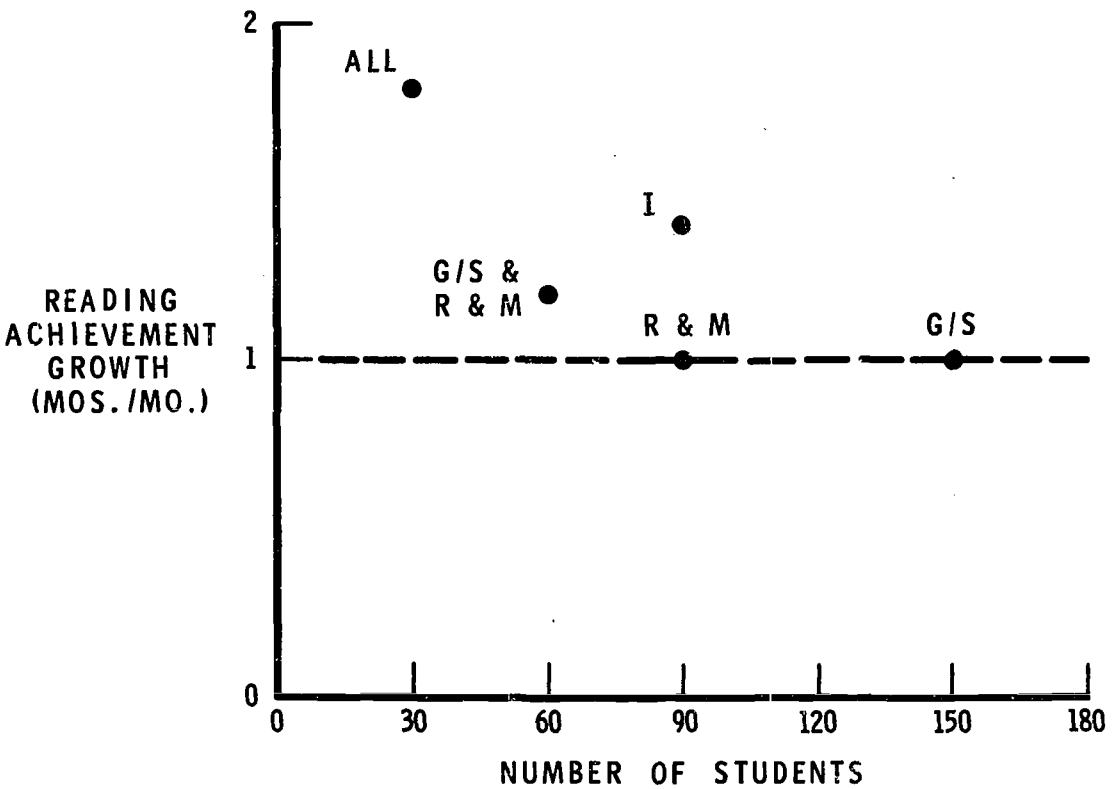

Fig.9

TWO MEASURES OF EFFECTIVENESS — FIRST ASSUMPTION

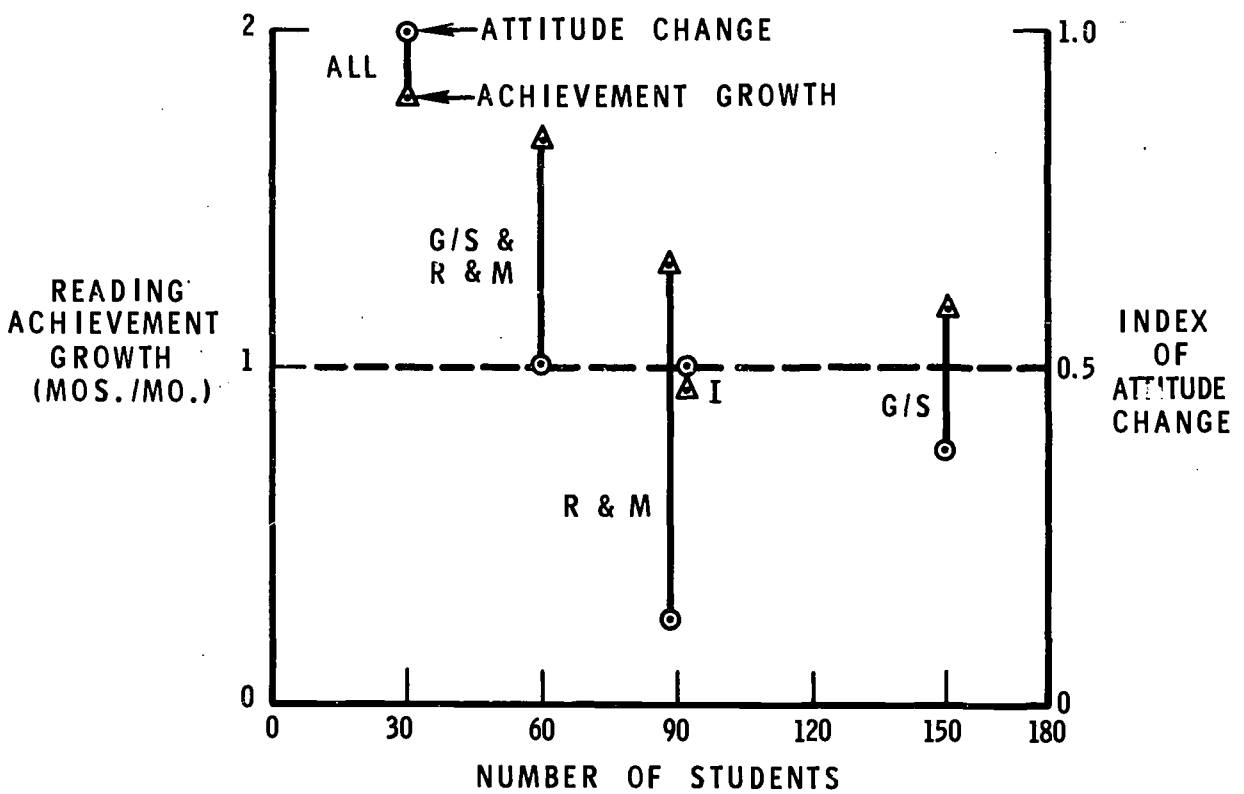

Fig. 10

induce a change in attitude relative to the change induced by the R-3 program. Thus, the index of attitude change for the R-3 program is unity, and the other alternatives have indices less than this.* As before, gaming/simulation alone looks risky because it is not being reinforced with backup programs. In addition, it may induce relatively little attitude change; reading and math look even poorer in this regard, while the involvement is too low on achievement gains. Note how the addition of the second measure supports the superiority of the combination of reading and math with gaming/simulation over reading and math alone (refer to Fig. 8). Thus, we may want to accept smaller numbers of students and have reinforcing programs, as in the gaming/simulation and reading and math, where we buy achievement gain and attitude change for 60 students, or we may prefer to buy less of each for 150 students with the gaming/simulation alone. Which one a decisionmaker chooses will depend upon whether he considers gains per student or numbers of students reached more valuable.

Supposing we believe that the greatest contributor to achievement gain was the involvement. Then we would have a situation something like that depicted on Fig. 11. Now the choice is even more clearly in favor of the involvement over the gaming/simulation than before. The gaming/simulation and reading and math cannot compete with it on any measure and only gaming/simulation alone is superior--in terms of numbers of students only.

We have gone through this kind of analysis to demonstrate how it can assist decisionmakers in choosing among alternative programs by considering effectiveness alone. It also demonstrates the value of being able to attach measures of effectiveness to alternatives. (Recall that we could only hypothesize what the effectiveness would be.)

*A slight digression at this point will help to explain the rationale behind this figure. Analysts have a tendency to lump all measurables in single indices for the sake of simplicity of manipulation and presentation. For example, the number of students in each alternative program might have been included in the indices. Although this would have made for a very pretty picture, it would have been almost impossible to interpret because too many variables would be combined in a single point. As far as possible, it is better to keep measures that are significant in their own right separate.

TWO MEASURES OF EFFECTIVENESS — SECOND ASSUMPTION

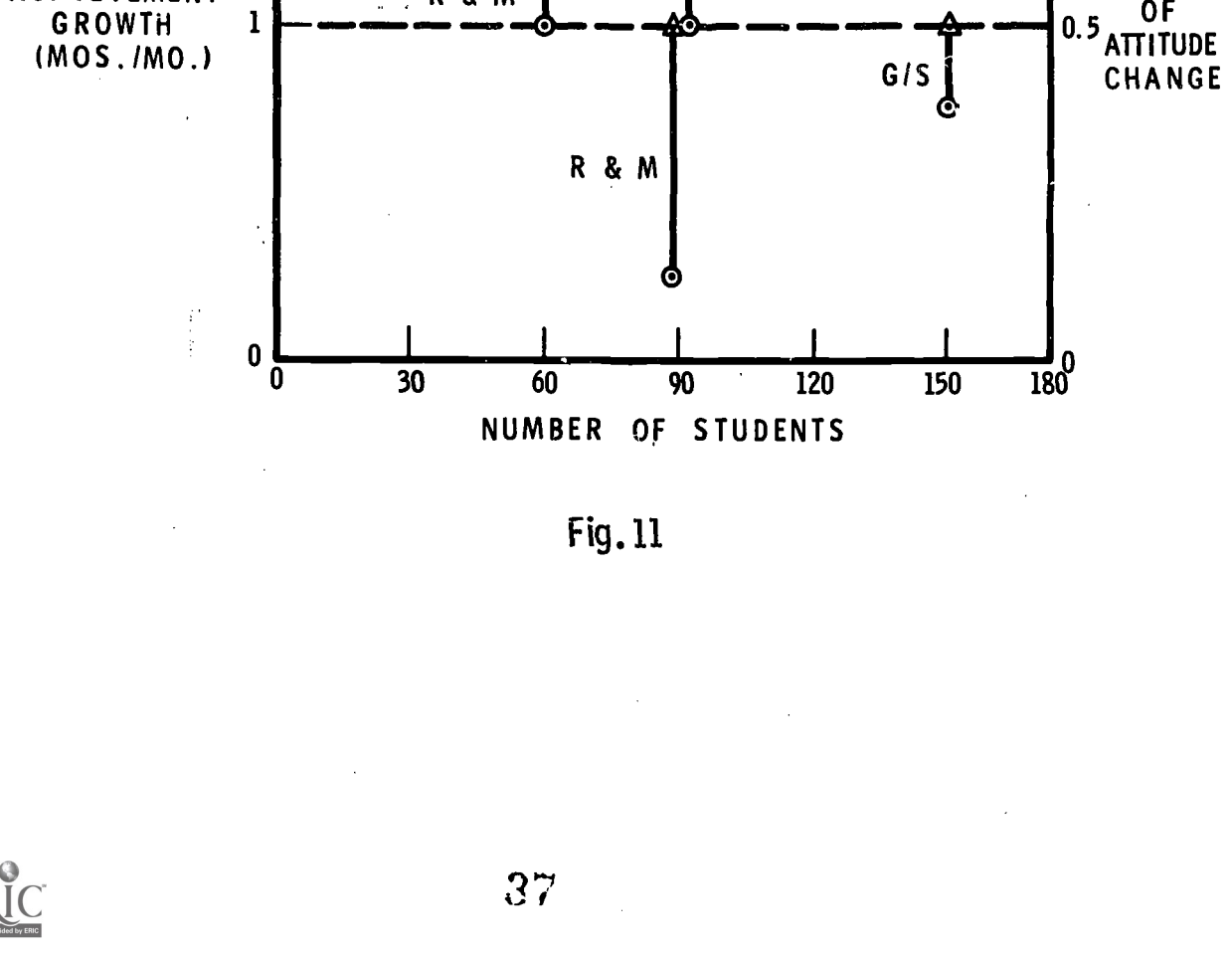

Fig. 11

But even though the analysis had to be made in the absence of solid data, at the least it has made subjective judgments explicit and related them to one another in an orderly way.

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